Design for 24x7 Water Supply in Private sector Townships - A case study for Samudra Township (Mundra SEZ) of Adani Group.

By J.B. Kagathara
(Envirocare Engineers Ahmedabad)

Introduction : In our country almost in all metro-cities, Class-I cities & towns have intermittent water supply system. This is due to so many reasons like Political, Financial, lack of Engineering responsibilities etc.. It is also very complex issue for our country.

In certain private sectors in India, there are certain townships which have 24x7 water supply system. Here is an example of 24x7 WS system designed for Samudra township constructed on a Creek-land in phase -1 on about 125 acres area. Second & third phase are almost similar. Their total Reservation from Narmada GWIL pipeline is 6.0mld. In phase-I sector -5 & 6 are already developed for which water infrastructure.(WS, Sewerage & SWD) were designed by Veolia & in house by Adani Group.

Sector 7 & 8 water infrastructure (WS, Sewerage & SWD) is given to us (i.e. Envirocare-Engineers Ahmedabad). We have designed and delivered whole job in last year which is partially implemented & commissioned. Here in this seminar, we share our ideas how we have provided the overall design of WS 24x7 for 2.0MLD quantity at per capita rate of 250litres. Overall details are given below .

Project Area : The said project area is a part of Samudra Township extension sector 7 & 8 falling in Mundara Port & SEZ Ltd area layout West of IOCL terminal Mundra –Port. This area covers Sector-7 and Sector-8 having area of 20.55ha. & 20.80 hector respectively. The coverage area for this project is shown in the Master Plan enclosed.

Population : As planned township has got fixed housing numbers with other planned amenities as per Township Master Plan prepared by the Architect/ consultants .As per plan Residential Flats G+2 total houses with 04 persons/house are to be taken + other water requirements like shopping & commercial centres, school, hostel for trainee, knowledge city & club house etc are to be considered and to provide sufficient sized network for WS & Sewerage to cater requirement at **250LPCD** on 24x7 bases. Detailed requirement is calculated in the below mentioned table per day. Therefore designed population & total water demand for these sectors is proposed as shown below.

Water Demand : As per the standard laid down in the Manual of CPHEEO for Water supply 135LPCD is the minimum required level for functioning of sewerage scheme in city area. As shown above this township has got no other source as well as supply is to be made on 24x7 per capita WS rate is taken 250 lpcd.Therefore total ultimate requirement of water would be 2.00 MLD. As calculated in the below table.

Water Supply Proposed :

Sector No	Residential -Flats	Units	Population	Water Supply Quantity in liters
07	1BHK	40x12 = 480	1920	4,80,000.
	2BHK	39x12 = 468	1872	4,68,000.
	3BHK	15x12 = 1 80	720	1,80,000.
	School	01 = 01	-	30,000.
	Hostel for Trainee	01 = 200	200	50,000.
	Markets	-	-	20,000.
	Commercial plots	-	-	30,000.
	Knowledge city	-	-	30,000.
	Other Commercial plots	-	-	1,00,000.
08	2BHK	24x12 = 288	1152	2,88,000
	3BHK	12x12 =144	576	1,44,000.
	Bungalowscat.1 & 2	28 x1 = 28	112	28,000.
	Studio Apartment	50 x1 = 50	100	25,000.
	Club house	-	-	1,00,000.
	Temple complex	-	-	10,000.
	Water Demand	-	-	**19,83,000**
-	Add 05% Floating population demand	-	-	99,150
-	Total Water Supply	-	-	**20,82,150**

Note : Commercial, club house, market, school bldg. etc have been considered with LS requirement.

Review of Existing WS for Sector 5 & 6 :

WS design for sector 5 & 6 was reviewed by us and found that there is no possibility to augment its network for proposed sector 7 & 8. Therefore, it is planned to have a separate distribution pumping station for sector 7 & 8 as shown as under and to feed this distribution PS, a separate pipeline for 2.0Ml discharge in 16 hours is proposed from WTP pumping station.

TOTAL Water Demand for 7 & 8 :

Total demand = 1.478+0.532 = 2.01ml (Average flow =24lps)

In peak hours (with PF =3) morning 3 hours +3 hours evening, flow required is =72. lps .

Pumping unit at WTP Pump house , Transmission pipeline for Sector 7 & 8 :

Sector 7 & 8, is required an individual storage within the sector 7 & 8 which can satisfy the peak demand for morning 3hrs & evening 3hrs + a separate transmission pipe line of suitable diameter which can at least transfer total quantity of ultimate demand in at least 16 hours pumping.

Proposal based on the Client Requirement & our Recommendations :

1. Provide 250mm dia DI K-9 second treated filtered water supply pipeline from WTP to township sector 7 & 8 up to entry main road in approx length of 2300m.
2. Provide a storage of 4hours of 1080m3 for HPS-system for sector 7& 8.
3. Provide a transmission main pipeline of 250mm dia OD HDPE PN-10class from Township Entry main road of sector 7 & 8 to proposed Storage location as connectivity pipeline having length of 1100m.
4. Provide a separate HPS system at the Storage for sector 7 & 8.
5. Design the distribution network possible making loop pattern.
6. Design HPS system for long term plan for sector-7 & 8 and provision of pumps for transmission of 2.0mld water in 16 hours to HPS-storage at sector 7& 8.

Network Planning :

As in this township water is proposed to be distributed to each consumers/ residence / flat about 250 lpcd considering 04 persons / house , system is to be designed 24x7 bases. In this township, no UG storage and over head conventional system to each block is provided. Therefore for a building, having G +02 need at the point of connection point minimum pressure 2.0bar (20 to 18m head) which is sufficient for all internal plumbing designed.

Distribution Network :

An accurate and detailed water supply distribution system can be designed after the following information is available.

- Detailed survey of levels of the area/zones/sectors.
- Zones and their individual water requirements.
- Detailed internal layout of some sectors especially reserved sectors (as per the layout plan).
- Internal road networks inside the sectors.

Therefore here efforts are made providing a single main supply pipeline as loop network with branches and sub branches up to building supply point as per the geometry of town planning. To make Hydraulic more easy as whole township road formation levels are +7.5m, principle of Branched Network hf system has been adopted, dividing peak flow of 70 lps into two sides as per nodal demand into two sides. Hydraulics of network is designed based on Hazen-Williams formula.

Map of detailed designed distribution network, mentioning locations of joints, pipeline lengths, nodal demand , valves etc are incorporated in the drawing. Detailed hydraulic design is prepared with nodal demand and analysis is prepared considering peak demand with PF= 3 showing residual head available .

Water Demand of Proposed Buildings Sector 7 & 8			
Sr.No	Details	Number	Unit
1.	No of Building Planned	92	No
	No Of Flats	552	No.
	Population per flat	4	flat
	Total Population	2760	Person
	Water Supply Rate	200	LPCD
	Water Demand	552000	Litre/day
	Average flow	23000	litre/hour
	Peak Factor	3.0	-
2.	Calculation for line sizing	-	-
	Flow rate at Peak Demand	69000	litre/hour
	Water Flow rate	0.0192	m3/sec
	Velocity	1.5	m/s
	Area of pipe required	0.0128	Sq. M
	Pipe Diameter	0.1276	M
	Pipe Diameter ID	128	mm
	Pipe Diameter Provided HDPE PE-100 PN-10 .	160	mm OD
	No of Branches	5	
	Building per branch	23	Average
	Flow required per branch	0.0038	m3/sec
	Velocity	1.50	m/sec
	Area of pipe required	0.0026	sq. m
	Pipe Diameter	0.0571 57.06	m mm
	Size of Branch pipe provided HDPE PE-100 Pn-10	80	mm OD
-	In order to have equal pressure at all the points all branches are connected to form a close loop with header.	-	-

3	New header is proposed from the pumping station, with an isolation valve		
	Pump Head	40	m
	Loss in pump delivery line fittings up to Isolation Valve	2	m
	Available head at Valve chamber	38	m
a	Friction loss in 160 mm OD diameter main	-	-
	Flow	0.0192	m3/sec
	Area of cross section	0.018	m2
	velocity	1.085	m/sec
	Friction loss	16.7	m
	Head Available at Terminal Point of Header	21.32	m
b	Friction loss in longest branch	-	-
	Length of longest branch	425.56	m
	Diameter of pipe	0.08	m
	flow	0.0038	m3/sec
	Area of cross Section	0.005	Sq. M
	Velocity	0.763	m/sec
	Friction Loss	6.554	m
	Residual Head Available at Terminal Point of Branch	**14.7610**	m

Conclusion :

14.7610 m residual head is available at terminal point of longest branch. This is to check for the worst condition. Actually all branches are looped hence available residual head will be higher than 14.7610. This head is sufficient for providing water up to building top .

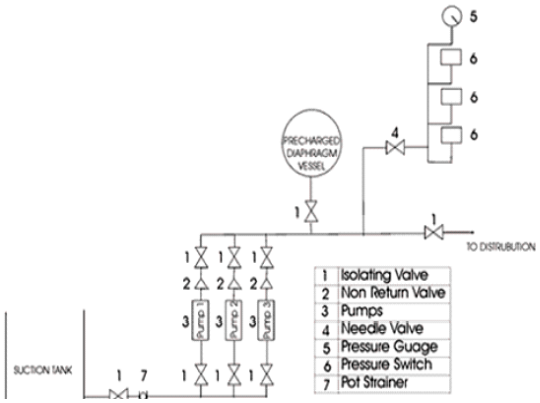
Hydro pneumatic System

The hydro pneumatic system consists of a pressure vessel and a pressure pump. The pressure vessel contains water with a pressurized air space to provide the pressure for the system. With water demand, water flows from the vessel, increasing the air space as well as decreasing air pressure. This lower pressure signals the pump to start. The pump meets the demand with the excess volume backing up in the pressure vessel. This decreases the air space and increases the pressure once again. When the upper level is reached, the pump shuts off. The newer pressure vessels have a neoprene bladder to separate the air space from the water.

Hydro Pneumatic Variable Speed Drive Constant Pressure System

The latest and most efficient method of water supply is by using electrically driven pumps with variable speed drives so as to maintain a fixed predetermined constant pressure in spite

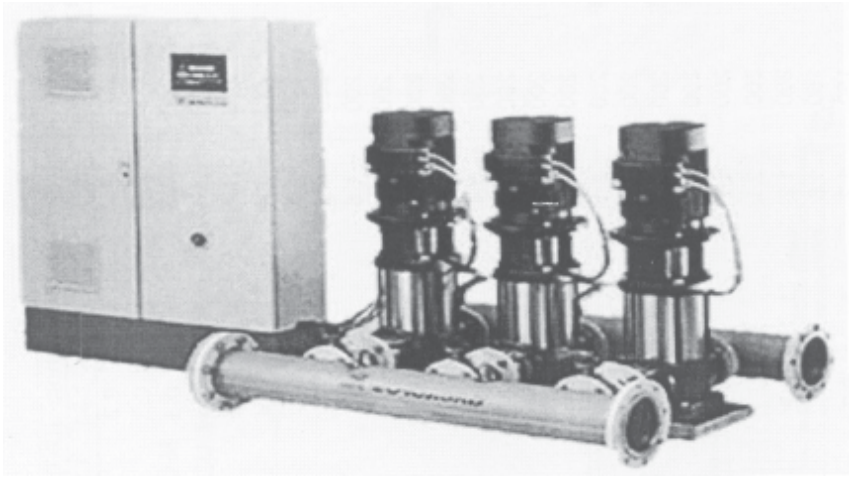
of variable consumption. The equipment basically comprises of centrifugal pumps driven by standard squirrel cage induction motor. The variable speed is achieved by a frequency convertor which changes the electrical frequency from standard 50 cycles to a figure both higher or lower so as to achieve speed for say, 4- pole motors from a standard 1500 RPM synchronous at 50 cycles upto 2000 RPM on the higher side and more or up to 1000 RPM or less on the lower side. This is automatically achieved through a PID (Potential Integral Differential) controller and a pressure transducer.



Pumping System Designed Capacity :

Therefore, as per above calculations and use of existing pumps 03 working sets +01 stand by having each pump discharge capacity = 90m3/hr (25lps x 03 =) with system head of 30.00 m. 20HP each.

PHOTOGRAPH OF TYPICAL PUMPS.

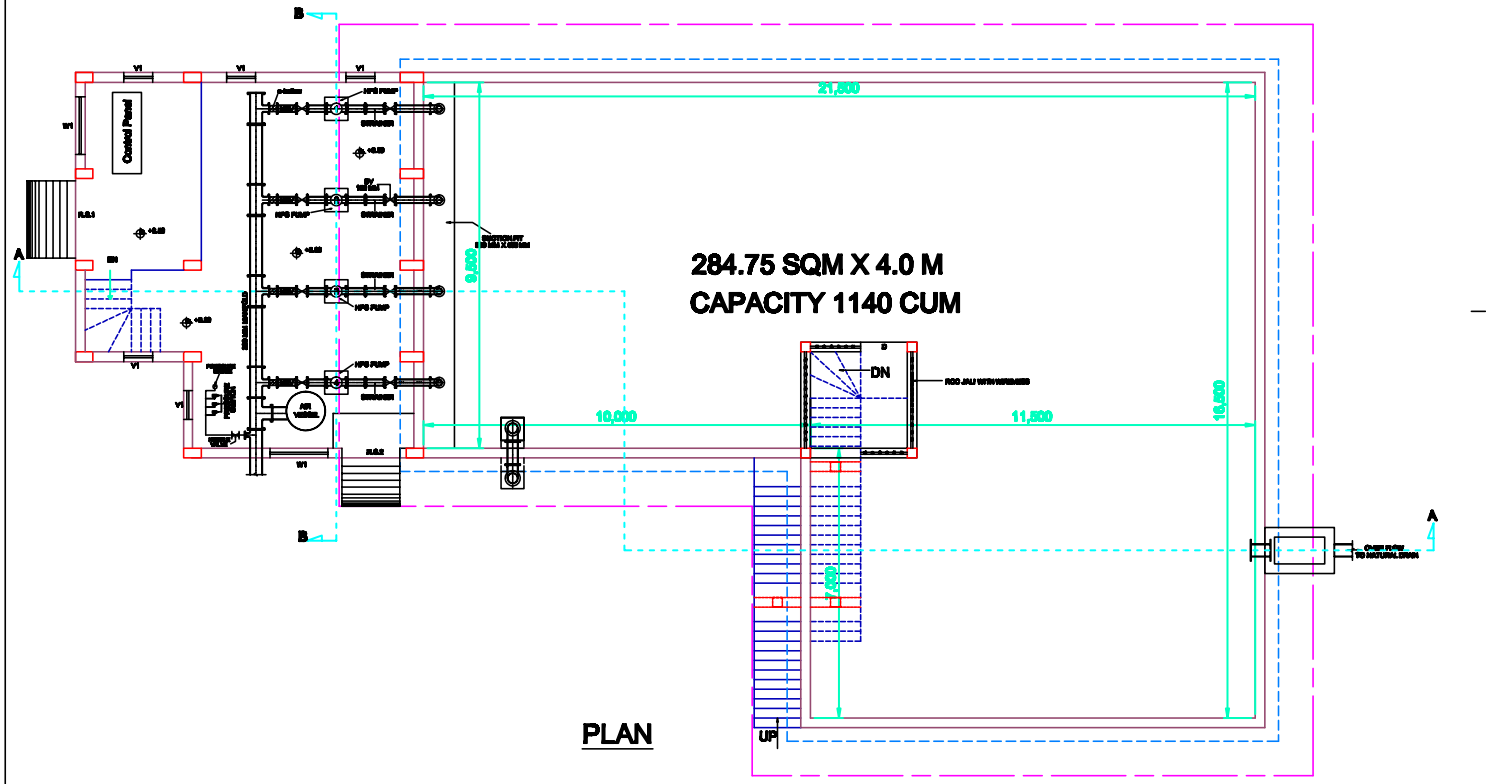


Break-up of Estimated Cost of the works.

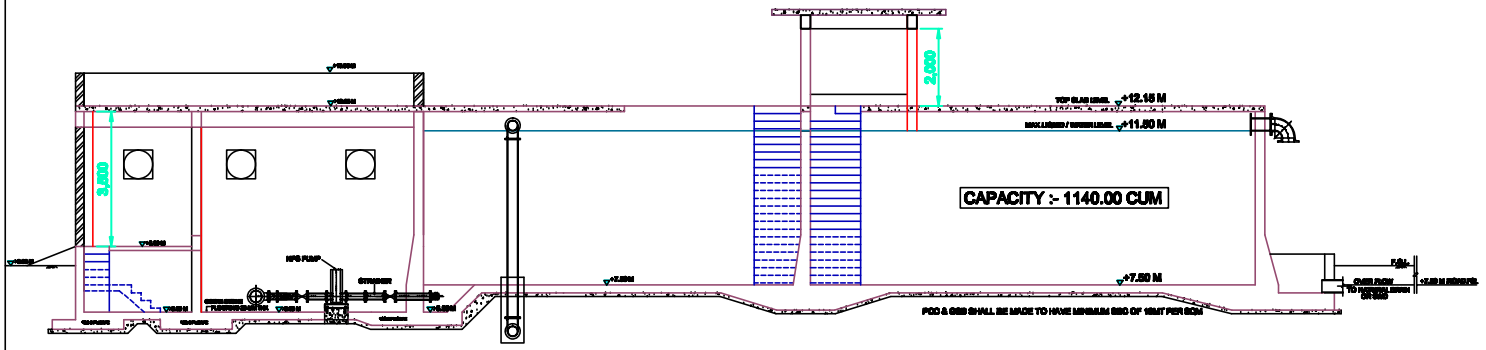
Sr. No	Name of Work-component	Estimated cost in Rs. (Approx)
1.0	BOQ of DI supply/ transmission main lines from WTP to HPS-Storage	1,10,09,488.00
2.0	BOQ of Distribution network	5 3,63,254.00
3.0	BOQ of WS Storage -Pumping station Civil works.	44,70,000.00
4.0	BOQ of Pumping machinery Hydro-pneumatic pumps, (3working+1standby) piping, manifold, installation, commissioning with one warranty.	44,25,000.00
5.0	BOQ of Pumping machinery (2 working +1 stand by) at WTP for transmission of water to Township sump including piping manifold, installation, commissioning with one year warranty.	11,80,000.00
6.0	Total Cost of WS works in Rs. Approx. **Rs .2,64,48,000**. **Per KL capital Cost = Rs. 13.22 (Total Population=8000)** **Per Capita Capital Cost = Rs. 3305.** **O & M cost per KL = Rs. 2.85**. (Cheaper than Muni. local body)	2,64,47,742.00

Drawing On Next pages

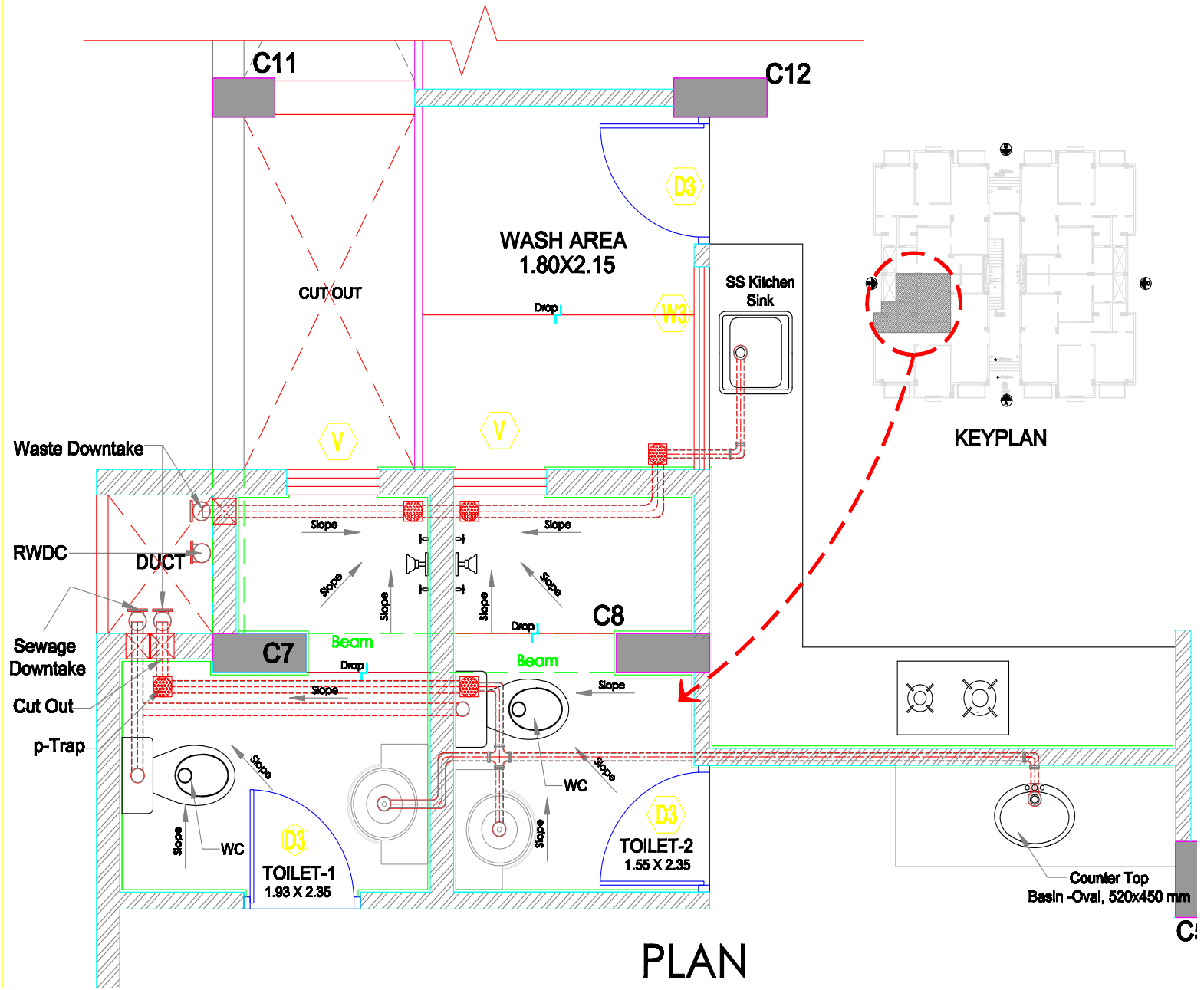
(79, 80)



PLAN



SECTION A- A


C11
C12
D3
WASH AREA
1.80X2.15
CUT OUT
Drop
W3
SS Kitchen
Sink
V
V
Waste Downtake
RWDC
DUCT
Sewage
Downtake
Cut Out
p-Trap
Slope
C7
Beam
Drop
C8
WC
TOILET-1
1.93 X 2.35
TOILET-2
1.55 X 2.35
KEYPLAN
Counter Top
Basin -Oval, 520x450 mm
PLAN